WHAT IS CLAIMED IS:

1.   A method for determining the aspect ratio in a channeled heat exchanger for gaseous fluids in which the channels have a surface area density greater than 10000 m^2/m^3 and a constant volume comprising:

determining the thermal performance of the heat exchanger

to obtain data with regard to a channel corresponding to heat transfer rate, velocity and flow;

plotting the performance curves of 1) pressure loss in the channel for the hot side; 2) pressure loss in the channel for the cold side; 3) heat flux; and 4) heat transfer rate against an axis corresponding to aspect ratio;

determining a range of aspect ratios based on the curves plotted in which the points on the aspect ratio axis corresponding to the intersections of the maximum and minimum of the gradients of the heat flux and heat transfer curves define the range.

2.   The method of claim 1 in which the thermal performance of the heat exchanger is determined in accordance with the formulae:

$$\frac{\partial}{\partial x_i}(\rho u_i) = 0 \ ;$$

$$\rho u_j \frac{\partial u_i}{\partial x_j} = -\frac{\partial p}{\partial x_i} + \rho g_i + \frac{\partial \tau_{ij}}{\partial x_j} \quad \text{where} \quad \tau_{ij} = \mu\left(\frac{\partial u_i}{\partial x_j} + \frac{\partial u_j}{\partial x_i}\right) + \left(\beta - \frac{2}{3}\mu\right)\frac{\partial u_k}{\partial x_k}\delta_{ij};$$

and

$$\rho u_i \frac{\partial h}{\partial x_i} = \frac{\partial p}{\partial t} + u_i \frac{\partial p}{\partial x_i} + \phi + \frac{\partial}{\partial x_i}\left(k \frac{\partial T}{\partial x_i}\right) \quad \text{where} \quad \phi = \tau_{ij} \frac{\partial u_i}{\partial x_j} \ .$$

3.   A method for determining the aspect ratio in a channeled heat exchanger for gaseous fluids in which the micro channels have a surface area density greater than 10000 m^2/m^3 and the design specifications for the volume of the channels are variable and require an aspect ratio less than or equal to 10, comprising:

determining the thermal performance of the heat exchanger to obtain data with regard to a channel corresponding to heat transfer rate, velocity and flow;

plotting the performance curves of 1) pressure loss in the channel for the hot side; 2) pressure loss in the channel for the cold side; 3) heat flux; and 4) heat transfer rate against an axis corresponding to aspect ratio;

determining a range of aspect ratios based on the curves plotted in which the points on the aspect ratio axis corresponding to the intersections of the maximum and minimum of the gradients of the heat flux and heat transfer curves define the range; and

from the range, determining the dimensions of the micro channels in accordance with the steps of.

determining Nu based on fluid properties;

fixing an allowable pressure loss ΔP ;

predetermining a channel length, ℓ , for a given space;

calculating b from the equation: $b^4 = \dfrac{12 \mu k_f Nu \ell^2}{\rho c_p \Delta P}$;

determining $AR_{opt} = \{(H_1, w_1), (H_2, w_2), \ldots\ldots, (H_n, w_n), \ldots\ldots\}$, $w_c = b$;

determining $AR = \dfrac{H}{w_c}$, $H = w_c AR_{opt}$; and

determining $w_s = H\sqrt{\dfrac{k_f Nu}{6k_s}}$, $w_s = w_c AR_{opt}\sqrt{\dfrac{k_f Nu}{6k_s}}$.

4.   The method of claim 3 in which the thermal performance of the heat exchanger is determined in accordance with the formulae:

$$\frac{\partial}{\partial x_i}(\rho u_i) = 0 \quad ;$$

$$\rho u_j \frac{\partial u_i}{\partial x_j} = -\frac{\partial p}{\partial x_i} + \rho g_i + \frac{\partial \tau_{ij}}{\partial x_j} \quad \text{where} \quad \tau_{ij} = \mu\left(\frac{\partial u_i}{\partial x_j} + \frac{\partial u_j}{\partial x_i}\right) + \left(\beta - \frac{2}{3}\mu\right)\frac{\partial u_k}{\partial x_k}\delta_{ij} ;$$

and

$$\rho u_i \frac{\partial h}{\partial x_i} = \frac{\partial p}{\partial t} + u_i \frac{\partial p}{\partial x_i} + \phi + \frac{\partial}{\partial x_i}\left(k\frac{\partial T}{\partial x_i}\right) \quad \text{where} \quad \phi = \tau_{ij}\frac{\partial u_i}{\partial x_j} .$$

5.   The method of claim 3 in which the validity of the dimensions determined is verified by application of the formula:

$$\frac{H}{b} \ll \pi^2\left[\frac{k_s}{6k_f Nu}\right]^{1/2} .$$

6.   A method for determining the aspect ratio in a channeled heat exchanger for gaseous fluids in which the micro channels have a surface area density greater than 10000 m^2/m^3 and the design specifications for the volume of the channels are variable and require an aspect ratio greater than 10, comprising:

determining the thermal performance of the heat exchanger in accordance with the formulae to obtain data with regard to a channel corresponding to heat transfer rate, velocity and flow;

plotting the performance curves of 1) pressure loss in the channel for the hot side; 2) pressure loss in the channel for the cold side; 3) heat flux; and 4) heat transfer rate against an axis corresponding to aspect ratio;

determining a range of aspect ratios based on the curves plotted in which the points on the aspect ratio axis corresponding to the intersections of the maximum and minimum of the gradients of the heat flux and heat transfer curves define the range; and

from the range, determining the dimensions of the micro channels in accordance with the steps of.

determining Nu based on fluid properties;

fixing an allowable pressure loss ΔP;

predetermining a channel length, ℓ, for a given space;

calculating b from the equation: $b^4 = \dfrac{12\mu k_f Nu\ell^2}{\rho c_p \Delta P}$;

calculating α from the equation: $\alpha = \dfrac{k_f Nu}{k_s}$;

determining $AR = \dfrac{H}{w_c}$ and $w_c = \dfrac{2^{1/6} b^{4/3}}{\alpha^{1/6} H^{1/3}}$: $w_c = \dfrac{2^{1/8} b}{\alpha^{1/8} AR_{opt}^{1/4}}$; and

determining $AR = \dfrac{H}{w_c}$: $H = w_c AR_{opt}$.

7. The method of claim 1 in which the thermal performance of the heat exchanger is determined in accordance with the formulae:

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$$\frac{\partial}{\partial x_i}(\rho u_i) = 0 \ ;$$

$$\rho u_j \frac{\partial u_i}{\partial x_j} = -\frac{\partial p}{\partial x_i} + \rho g_i + \frac{\partial \tau_{ij}}{\partial x_j} \quad \text{where} \quad \tau_{ij} = \mu\left(\frac{\partial u_i}{\partial x_j} + \frac{\partial u_j}{\partial x_i}\right) + \left(\beta - \frac{2}{3}\mu\right)\frac{\partial u_k}{\partial x_k}\delta_{ij} \ ;$$

and

$$\rho u_i \frac{\partial h}{\partial x_i} = \frac{\partial p}{\partial t} + u_i \frac{\partial p}{\partial x_i} + \phi + \frac{\partial}{\partial x_i}\left(k\frac{\partial T}{\partial x_i}\right) \quad \text{where} \quad \phi = \tau_{ij}\frac{\partial u_i}{\partial x_j} \ .$$

8.   The method of claim 6 in which the validity of the dimensions determined is verified by application of the formula:

$$\frac{H}{b} >> \frac{\pi^{0.75}}{(2\alpha)^{0.25}} \ .$$

9.   A micro channel heat exchanger in which the channels have dimensions determined in accordance with the method of claim 1 or claim 2 or claim 3 or claim 4 or claim 5 or claim 6 or claim 7 or claim 8.

10.   A system for manufacturing a micro channel heat exchanger comprising:

determining the maximum allowable pressure loss and the flow rate of hot fluid and cold fluid on the opposite sides of the channels; and

optimizing the channel height, channel width and the thickness of a solid material between channels in accordance with the method of claim 1 or claim 2 or claim 3 or claim 4 or claim 5 or claim 6 or claim 7 or claim 8;

adapting the optimized dimensions obtained in the step of optimizing to the requirements of a given manufacturing specification by compromising the optimized dimensions to the requirements of a manufacturing design for the micro channel heat exchanger.

11. A system of claim 10 in which a predetermined pumping power is a determinant of the maximum allowable pressure loss.

12. A system of claim 10 in which the determination of the maximum allowable pressure loss and the flow rate of hot fluid and cold fluid on the opposite sides of the channels is a function of a predetermined dimension established for the channels.

13. The system of claim 12 in which the predetermined dimension established for the channels is length.

14. A micro channel heat exchanger having channels with dimensions that compromise the dimensions determined in accordance with the method of claim 1 or claim 2 or claim 3 or claim 4 or claim 5 or claim 6 or claim 7 or claim 8 with the requirements of a predetermined manufacturing specification.